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APPLICATION OF CONCENTRATED SPRAY WITH HAND EQUIPMENT

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The development of concentrated sprays for insect control has so increased the speed and ease of application of insecticides that hand apparatus can be used to treat much larger areas than has been possible with dilute sprays. With this development have come improvements in such equipment. The equipment available in 1942 was described by the author in E-574, entitled "Equipment Available for Applying Concentrated Sprays." The purpose of this publication is to bring up to date the information on hand equipment for the application of concentrated sprays. In this paper a concentrated spray is considered to be one in which the concentration of the toxicant is more than seven times the concentration in an ordinary dilute spray.

Hand Atomizers

Figure 1.--Hand atomizer.

Most hand atomizers utilize a plunger-type air pump to develop a continuous air pressure of 2 to 5 pounds per square inch. In one type the air pressure is applied to the surface of the liquid in the container to force it through nozzles with orifices 1/32 to 1/16 inch in diameter. In another the liquid is drawn from the spray tank through a tube by means of suction caused by air from the pump rushing across the open end of the tube (fig. 1).

The second type of atomizer produces drops averaging 20 to 50 microns in diameter and can spray suspensions as well as solutions and emulsions. It is usually preferred to the first type, which is more expensive and has a tendency to clog when suspensions are used. This atomizer has a liquid orifice 1/12 to 1/8 inch in diameter, large enough to prevent frequent clogging. It discharges liquid at a slow rate, permitting fine atomization and thus lessening the tendency to overspray. The air orifice is 3/32 to 1/8 inch in diameter. For any given air pressure, drop diameter and volume decrease with increase in size of the air orifice and with decrease in size of the liquid orifice. The size and position of the liquid tube in relation to those of the air orifice of the air pump are very important. The liquid orifice should be 1/32 to 1/16 inch forward of the air orifice and 1/64 inch below its center.

There is still room for improvement in hand atomizers. Among the weaknesses of those on the market today are (1) corroding of the tank and liquid tubes, (2) short life of the air-pump plunger, (3) tendency for the spray to drip onto floors or furniture, (4) inability of the operator to see the liquid in the spray tank or to measure precisely the quantity of liquid that is being applied, (5) difficulty of stirring the spray mixture in the tank, and (6) difficulty of cleaning and rinsing the sprayer.

Some of these weaknesses can be eliminated by using a sprayer tank of glass or plastic instead of metal. However, if a tank is constructed of metal, copper or prime galvanized metal should be used. Some practical way of installing a feed tube that can be readily removed and cleaned with a wire or pipe cleaner would be advantageous.

Extension rods or nozzles that permit directing the spray at any desired angle are useful for spraying plants that are less than 2 feet high.

Electric Atomizers

There are two types of hand atomizers that are operated by electricity. In one a 1/10- to 1/3-hp. electric motor is used to drive a small compressor which delivers compressed air through an orifice in the nozzle. By this method the spray can be atomized as finely as by an aerosol bomb. The second type employs a fan or blower to atomize and propel the spray mist. It has much greater drive, air volume, and spread of air stream than the first type.

Knapsack Sprayers

The usefulness of knapsack sprayers for applying concentrated sprays depends on the rate of delivery and efficiency of the nozzles. Most nozzles deliver too much spray and do not atomize it sufficiently. Knapsack sprayers are normally operated with a direct pressure on the liquid of

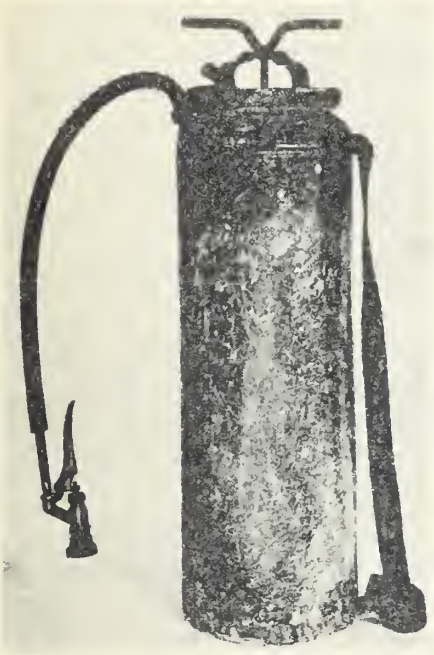

Figure 2.--Compressed-air knapsack sprayer with hand-operated air plunger pump.

30 to 75 pounds per square inch, and atomization is effected by conventional nozzles. Pressure may be developed by compressed air, as from an air-plunger pump in round tanks (fig. 2), or by hydrualic pressure developed by a hand-operated plunger (fig. 4) or by a diaphragm or plunger pump.

The knapsack sprayers now available are not very satisfactory for applying highly concentrated suspensions. The larger orifice needed to disperse the wettable powder delivers too much liquid, and the drops are too coarse. For dispersing solutions and emulsions oil-burner type nozzles that deliver 2.5 to 6 gallons per hour are satisfactory unless it is necessary to drive the mist to the underside of dense foliage. To avoid clogging it is important to start with a clean tank equipped with a 14- to 20-mesh strainer on the intake pipe at the bottom. The mixture should be well shaken and then poured into the tank through a funnel containing a 30- to 40-mesh strainer. It should also be shaken during the spraying operation. The application should be made with a pressure of at least 35 pounds per square inch. When a spray job is completed, the sprayer should be thoroughly rinsed and dried to prevent rusting.

With some types of knapsack sprayers carbon dioxide can be used to provide pressure for applying the liquid (fig. 3).

The common faults of present-day knapsack sprayers are listed below with some suggested remedies, for the information of manufacturers and users of such equipment.

(1) The hose is too short. A length of 4 to 5 feet is needed to provide sufficient reach and leverage.

(2) Gaskets, plunger rubbers, and packings are easily decomposed by oil solvents, oils, and various other chemicals.

(3) The mixture in the tank is not completely discharged. This fault can be remedied by having the intake pipe extended to the tank's bottom.

(4) They do not have durable, dependable shut-off valves that do not leak.

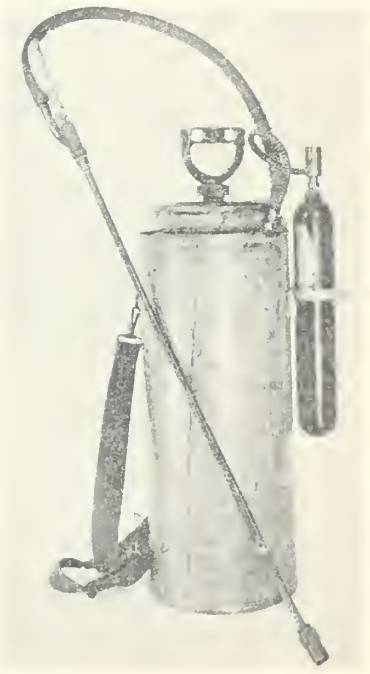

Figure 3.--Knapsack sprayer using carbon dioxide for producing pressure.

Figure 4. --Knapsack sprayer with hand-operated hydraulic plunger pump.

(5) The sprayers, particularly those of the hand-operated hydraulic types, tend to leak onto the back of the operator. This is a serious fault when certain solvents and poisons are used. Air-tight gaskets and covers help remedy this condition.

(6) The tanks tend to corrode and rust.

(7) Extention rods longer than 3 feet are too heavy. A light-weight metal, such as magnesium, should be used. If it is still too heavy, the extension rod should be strapped on a bamboo pole or placed inside of it by running the rod through a hole drilled the length of the pole.

How to Determine Amount of Spray to Use

For treating shrubs or areas of low growth it is necessary to know the size of the area to be covered in order to determine the quantity of insecticide to apply. The quantities of spray required for small areas equivalent to various rates per acre are given in table 1.

For treating barns, poultry houses, and other buildings with residual sprays, the quantity to apply per unit area of floor, ceiling, and wall varies with the insect, the insecticide, the toxicant concentration, and the deposit desired. Table 2 lists some quantities of sprays at different concentrations equivalent to given dosages of toxicant per 1,000 square feet (0.023 acre) of surface.

Table 1.--Volumes of spray for small areas equivalent to various volumes per acre

Volume per acre (gallons)	1/3 acre (14,520 sq. ft.)	1/5 acre (8,712 sq. ft.)	1/12 acre (3,630 sq. ft.)	1/40 acre (1,089 sq. ft.)	1/100 acre (436 sq. ft.)	1/800 acre (55 sq. ft.)
1	1 1/3 qt.	1/2 qt.	10.65 fl. oz.	3.2 fl. oz.	1.28 fl. oz.	0.16 fl. oz.
2	2 2/3	1	1.33 pt.	6.4	2.56	0.32
4	1 1/3 gal.	2	1.33 qt.	12.8	5.12	0.64
5	1 2/3	1 gal.	1.66	1 pt.	6.4	0.8
7 1/2	2 1/2	1 1/2	2.5	1.5 pt.	9.6	1.2
10	3 1/3	2	3.33	1 qt.	12.8	1.6
15	5	3	1.25 gal.	1.5 qt.	1.2 pt.	2.4

Table 2. --Quantities of sprays of different concentrations to apply to obtain various dosages of toxicant per 1,000 square feet ceiling, floor, or wall surface

Percent of toxicant in spray	2 grams	4 grams	8 grams	10 grams	15 grams	25 grams	50 grams	100 grams
1	7 fl. oz.	14 fl. oz.	1.7 pt.	2.2 pt.	3.3 pt.	2.6 qt.	5.2 qt.	10.4 qt.
2	3.5	7	14 fl. oz.	17.5 fl. oz.	1.6	1.3	2.6	5.2
3	2.16	4.32	8.6	11	1.1	1.7 pt.	3.4 pt.	3.4
4	1.7	3.5	7	8.7	12.5 fl. oz.	1.3	2.6	2.6
5	1.3	2.6	5.3	7	10	16.6 fl. oz.	1.1 qt.	2.2
6	1.1	2.2	4.3	5.5	8	14	28 fl. oz.	3.5 pt.
7.5	0.9	1.8	3.6	4.5	6.7	11.1	22.2	2.8
10	20 ml.	1.3	2.6	3.3	5	8.3	16.6	2.1
12.5	16	1	2	2.6	4	6.7	13.3	26.6 fl. oz.
25	8	16 ml.	1	1.3	2	3.3	6.6	13.3